

Understanding Hospital Readiness for Computerized Physician Order Entry

Dona Stablein, RN, MBA
Emily Welebob, RN, MS
Elizabeth Johnson
Jane Metzger
Robert Burgess
David C. Classen, MD, MS

Many hospitals in the United States are in the early stages of decision making and planning for computerized physician order entry (CPOE). Estimates regarding the percentage of hospitals that have achieved widespread CPOE adoption are consistently low—in the range of 3%–10%.^{1–3} It is well accepted that this change in how orders for hospitalized patients are created and managed is early in its adoption.

Implementing CPOE is a complex and difficult undertaking for a number of reasons. First, the changeover to physicians placing electronic orders significantly alters the order management process and thus affects the work flow of physicians, nurses, and others in the hospital. Few processes and departments remain untouched, as many changes must occur across departments and disciplines.

Second, many hospitals lack prior experience with clinical information systems, which affects how physicians organize and accomplish their work. This translates into the need for an information technology (IT) infrastructure that provides system access for all clinical users wherever it is needed, IT processes that are designed to provide almost instantaneous response to physician entries, training designed specifically for physicians, and system reliability for a mission-critical clinical application.

Third, advanced clinical information systems provide organizations with functionality that can standardize clinical practice and guide clinician decision making at the point of care. Each organization must decide to what extent, where, and when it wants to implement these new capabilities. Success in this requires new relationships and a high level of collaboration between IT, clinicians, and executive staff. In some hospitals, implementation of CPOE represents the first time the medical staff has collaborated with other disciplines to reduce variations in

Article-at-a-Glance

Background: Many hospitals in the United States are in early stages of decision making and planning to implement computerized physician order entry (CPOE) to improve patient safety and quality of care. The targeted processes and the software for CPOE are complex, and implementation is a large-scale change effort for most hospitals. Hospitals can increase the likelihood of success by understanding and addressing gaps in CPOE readiness.

Assessing CPOE readiness: A CPOE readiness assessment tool was developed that includes several different components: external environment; organizational leadership, structure, and culture; care standardization; order management; access to information; information technology composition; and infrastructure. The presence or absence of these indicators in a particular hospital was determined by on-site interviews, walkarounds with direct observations, and document review.

Results: Assessment results for the first 17 hospitals (bed size, 75–906 beds) indicated that the lowest average component score was in care standardization, while the highest average component score was in organizational structure and function. Organizational culture and the order management process also had low average scores.

Conclusions: This CPOE readiness assessment revealed significant gaps in all the hospitals examined. Identifying these gaps and addressing them before CPOE implementation can reduce risks. Organizations need to develop expertise at accomplishing and sustaining change; understanding and building CPOE readiness is an important first step.

care. Clinical decision support tools—the mechanism for integrating knowledge-based prompting and error checking—are new territory for most hospitals.

Fourth, CPOE implementation is not a project with a defined endpoint but a critical tool for ongoing safety and quality improvement. Processes and structures to manage the CPOE clinical decision support toolbox on a sustained basis must be developed. In essence, CPOE is IT-enabled quality improvement.

Fifth, the software for CPOE is just one application in a clinical application suite—never the first and usually the last application to be rolled out. This greatly increases the time, resources, and complexity of the effort.

CPOE implementation is a daunting challenge in any hospital; the risk of failure is great, and achieving widespread adoption and the desired improvements in patient safety and quality is difficult. The size of the required investment^{4,5} makes it even more important to maximize the likelihood of success. External demands to improve patient safety and requirements from accreditation agencies add to the pressure to get the job done as quickly as possible. Some hospitals have the added pressure of replacing clinical systems being sunsetted by the vendor or homegrown systems held together by a thread.

The earliest implementations of CPOE occurred in academic medical centers, many of which used homegrown clinical applications.⁶⁻⁹ Community hospitals have started to join the group of success stories, and today all hospitals are most likely to use the clinical application suite of a commercial vendor.^{3,10}

A sufficient number of health care organizations with successful implementation now exists to provide insight into what it takes in organization, process, and technology to be successful with CPOE. These industry-leading organizations have the characteristics of innovators and very early adopters, with the primary CPOE focus being attainment of a vision that would improve patient safety and quality. Yet a number of hospitals have experienced failure in attempting to implement CPOE; these failures have been traced to a number of common attributes.^{3,11,12}

Lessons from the successes and failures guided the development of a tool to assess how ready hospitals are to implement CPOE. This article describes a process and framework for assessing hospital CPOE readiness and reports the results from CPOE readiness assessments in

the first 17 hospitals assessed. Results from these hospitals provide insight into the typical operational and technology gaps that hospitals will need to address before CPOE is likely to become a widespread industry practice.

Assessing CPOE Readiness

A consulting firm developed a proprietary CPOE readiness assessment in fall 2001 to assist hospitals in understanding their organizational strengths and weaknesses and developing plans that increase their probability of achieving value from CPOE. To design the assessment tool, the fairly limited literature on what it takes to be successful with CPOE and what leads to failure was supplemented with information from a number of sources:

- Lessons learned in a large number of clinical change management and/or clinical system implementation projects conducted by the firm;
- Observations from five hospital site visits to test the CPOE evaluation approach of The Leapfrog Group¹³; and
- Insight gained during site visits and participation in the Nicholas Davies Recognition Program,¹⁴ which recognizes many of the successful early adopters of CPOE.

Designing an assessment begins with identifying the key prerequisites for successful CPOE implementation. The prerequisites were identified through research of CPOE success stories, stalled efforts, and failures. The next step was translating prerequisites into observable characteristics or indicators (for example, organizational structures, past experience, opinions of key executives, managers, and clinicians) that could be evaluated from information obtained during document review and interviews. For example, how to assess the receptivity of hospital culture to a large-scale change in clinical practice (for example, past history of successes, organizational resilience, widespread confidence of success with change) and the state of technology infrastructure and support (for example, history of use and performance of clinical systems, network design, mobile device strategy, and clinician perceptions of IT support) had to be specified.

The readiness assessment evaluates nine components of readiness, with several indicators in each component. Completing the assessment relies on 3–5 days of interviews with key executives, physicians, IT staff, and other

clinicians; walkarounds with direct observation on patient care units; and document review. Documents reviewed include various hospital committee (for example, pharmacy and therapeutics, quality improvement, patient safety) meeting minutes and reports and business and information systems plans. Observations provide information about the organizational culture and order management process.

On the basis of information obtained from each hospital, the presence or absence of each indicator is determined, and an overall score is calculated. The potential score for each component is 100, and the actual score is based on the number of indicators that are in place. The more indicators that are in place, the higher the score. The scores are then used to establish priorities for areas the organization should focus on to improve CPOE readiness.

Components of Readiness

The readiness components were designed to achieve a balance between the people, structure, process, and technology indicators for CPOE implementation. There is a common belief, backed up by both industry successes and failures, that the challenges to implement CPOE lie more in the organizational and people factors than in the technology factors. The assessment is consistent with that belief, as only two of the nine components evaluate technology readiness.

At the time the assessment was developed, the components were all weighted equally. Not only was the health care industry's experience insufficient to draw on in weighting, but weighting was not required to help organizations improve the probability of their successful implementation of CPOE. On the basis of subsequent experience in examining readiness in a number of hospitals and additional industry research on success with CPOE,¹⁰ we now believe that some indicators should be more heavily weighted than others. We plan on making this enhancement in the next iteration of the assessment tool. Work on refining and validating the assessment tool is ongoing. Future work will include tracking progress in the hospitals assessed and validating recommendations based on project outcomes.

Table 1 (p 339) presents an overview of the readiness components.

Results

Summary Data

As of January 2003, the assessment tool had been applied to more than 30 hospitals. The analysis reported in this article is based on the results from the first 17 hospitals to undergo the on-site assessment. These hospitals are fairly diverse and are broadly representative of other hospitals in the United States that are likely to implement CPOE during the next 3–5 years. All the hospitals were in the Northeast and Midwest. Three are academic medical centers, and the remainder are community hospitals. In a majority of cases, the patients at community hospitals were managed by private practice physicians, despite the presence of residency programs, hospitalists and intensivists; the exception was one community hospital that employed a high percentage of the physicians. All but one of the hospitals is part of a multihospital health system. Bed size ranged from 75 to 906 beds. Nine of the hospitals are located in markets targeted by The Leapfrog Group.¹⁵

Summary scores for the 17 hospitals can be found in Table 2 (p 340). As indicated by the range in scores for individual components, readiness varies considerably from one hospital to another. However, this is not totally surprising because some hospitals were closer than others to implementing CPOE at the time of the assessment and hence had accomplished more of the up-front work.

At the individual hospital level, high scores in several components were often associated with high scores in other components. On the basis of this finding, we conclude that two factors—one on the organization front and the other on the technology front—significantly influence the overall readiness of an individual hospital.

Organizational front. On the organizational front, a major factor is the historical relationship between the hospital and the medical staff, as reflected by previous collaborative efforts to improve care quality and reduce practice variation:

- Are physicians leading quality improvement efforts?
- Are physicians actively participating in major hospital initiatives?
- Does administration have a successful track record of working with physicians to make changes in clinical practice?

When the hospital has a history and success with this type of collaboration, the necessary accountabilities and

Table 1. Overview of Computerized Physician Order Entry (CPOE) Readiness Components

Readiness component	Description	What it reflects
External Environment Market Regulation	External and internal forces that are pushing the organization to implement CPOE	Ease of making a convincing case that CPOE is the right thing to do
Organizational Leadership Accountability Vision Planning	The organization's commitment to CPOE as a top strategic priority	Commitment to lead and sustain a multiyear, resource-intensive change across departments and disciplines
Organization Structure and Function Physician Model Resources Communication	The presence and effectiveness of organizational structures, relationships, and processes needed to implement and maintain CPOE	Need to build individual and group roles and accountabilities and time for these to become proficient
Organizational Culture Success with improvement CPOE awareness Innovation	The organization's capacity to engage in and sustain large-scale change that has significant impact on clinical practice	Capacity and resilience needed to stay the course with a large-scale improvement effort
Care Standardization Commitment Experience Compliance	The organization's ability to adopt or develop standard care processes and implement them across the organization	Challenge of gaining agreement and acceptance to reduce unnecessary variation in care
Order Management Process Standardization Management Compliance	The present state of order management services, disciplines, and processes	Nature and extent of necessary work to devise more uniform clinical processes incorporating clinical decision support
Access to Information Availability of patient information Clinician use Clinical decision support	Clinician experience with clinical computing as an element of routine clinical work	Physician and nurse learning curve for computers in general, as well as clinical, computer functions
Information Technology (IT) Composition Clinical involvement IT services and support	The roles, skills, structure, and methodologies of the IT department	Capacity and skill sets of IT resources to support initial and ongoing CPOE efforts
IT Infrastructure Performance Hardware Networks	The physical infrastructure and technical components of CPOE	Ability to deliver the high level of access and reliability needed for CPOE

structures are present, with physicians having a direct voice in shaping the future clinical direction for the organization. Because CPOE is basically a performance improvement project (rather than a technology one), hospitals at the lower end in these components can be expected to have a much harder time building the necessary leadership, decision making, collaboration, and medical staff participation needed for CPOE.

Technology front. On the technology front, the state of baseline clinical systems and the organization's experience with clinical systems are key, especially the extent to which current functionality includes features that encourage physicians' adoption and use. Other indicators of readiness are the track record of meeting clinician user demands, a stable and robust technology infrastructure, and a strong skill mix in the IT department (for example, experience with large-scale clinical implementations, remote access, and mobile devices). Down the road, prior physician experience with clinical systems also translates into less training of physicians in system basics. Because of the importance assigned to CPOE, some hospitals are speeding up the usually slow rollout of clinical information systems into fewer increments over a shorter

Table 2. CPOE Readiness: Compilation of Assessment Results for 17 Hospitals

CPOE readiness components	Readiness score (mean range)
External Environment	57 (45–82)
Organizational Leadership	59 (21–95)
Organizational Structure and Function	70 (35–94)
Organizational Culture	51 (27–93)
Care Standardization	44 (25–100)
Order Management Process	53 (25–78)
Access to Information	56 (30–90)
Information Technology Composition	64 (24–94)
Information Technology Infrastructure	63 (47–73)*

* 13 hospitals.

implementation time line. This strategy requires a very quick ramp-up in all aspects of technology readiness.

Gaps in CPOE Readiness

External Environment

For every hospital in this study, at least one external factor was pushing CPOE as an important agenda, and a number of the hospitals experienced multiple factors, such as The Leapfrog Group and Joint Commission on Accreditation of Healthcare Organizations (JCAHO; Oakbrook Terrace, Ill) patient safety requirements and local market competition. This pattern is typical in many urban areas of the United States. For the industry as a whole, the driver of improving patient safety has made a big difference in both the level of activity around CPOE and the priority assigned to the effort.

Organizational Leadership

Hospitals that scored high in this component had internalized patient safety as a top priority, with clear executive-level accountabilities and organizational structures to support a dedicated patient safety program. Gaining value from CPOE requires designing the new processes and tools within the framework provided by the organization's safety/quality program. Hence, those hospitals that have clear accountabilities, structures, and processes regarding patient safety are ahead of the game in leveraging CPOE clinical decision support tools.

lishing the clinical vision. Preparations such as these establish common expectations and signal that the initiative is important, deliberate, and a critical area of readiness. Only one-half of the hospitals perceived CPOE as one of the top three priorities for the hospital, and assessment team members judged even fewer of the hospitals to clearly understand the magnitude of change involved. These results are both red flags because CPOE requires focus, persistence, and a large investment of resources.

Organizational Structure and Function

CPOE is undoubtedly the largest-scale clinical performance improvement effort a hospital will have ever undertaken, at least in terms of the direct involvement of every physician and every patient care unit. Thus, project structures for performance improvement and the hospital's track record in making changes in physician practice (regardless of how small) are among the indicators of readiness. Good news for the hospitals in this survey is that a majority had pre-existing multidisciplinary approaches to problem solving that included medical staff, nursing, and pharmacy. Having leadership and the perspectives of these clinicians at the table is critical, and it is all the better if there is a track record of working together.

However, many of the 17 hospitals had histories of improvement projects (with and without information systems) that exceeded time and/or budget and that had mixed success in achieving the desired outcomes. On the

basis of the combined experience of the assessment team, this is true all too often in the health care industry at large. The lesson is that the CPOE effort represents a stretch goal that alters existing committee structures, membership, and accountabilities to involve physicians in decision making at all levels. Hospitals that do not have the right structures and personnel with the right skills and experience quickly find that this gap translates into an investment of significant resources, either through hiring or outsourcing.

Organizational Culture

The hospital's culture and history with respect to change sets the stage for common purpose and trust that CPOE implementation is not only feasible but will deliver the desired outcomes. Culture matters for any change effort but is particularly important for CPOE because so many individuals and processes within the hospital are affected and because success requires a multiyear effort. The cultural backdrop and readiness for CPOE are also influenced by the organization's basic approach to innovation. Does the hospital pride itself on being a leader in innovation, among the first to adopt new practices and technologies, or does it prefer to wait until the dust has settled? Where the hospital sits on the technology adoption curve—innovator, early adopter, or middle majority (early or late)¹⁶—is important for CPOE because the industry as a whole is still building experience, and hospitals that are implementing CPOE now are in predominantly uncharted territory.

The assessed hospitals fell into two groups for this component of readiness: those with demonstrated success in large-scale initiatives and those with mixed success. Particularly telling is whether or not, as a rule, the hospital effectively deploys technology solutions to improve clinical care. This once again gets to the issue of a history of collaboration between the clinical and IT departments and the extent to which those departments have successfully negotiated their different viewpoints around design and implementation of clinical systems.

Care Standardization and Order Management

The care standardization and order management components cover the extent to which care has been

standardized throughout the organization and within the order management process in particular. Low scores indicate not only a need for more prework but also a higher risk of not achieving the necessary agreement and compliance to achieve the value of CPOE.

The mean scores for the hospitals assessed were much lower than desirable for both of these components. In terms of care standardization, a low score may reflect the difficulty of reducing practice variation in a paper-based process. However, the overall finding is that, while hospitals initiate efforts in this area, follow-through in terms of measuring compliance and effectiveness is often lacking. Before undertaking CPOE, each hospital has to come to grips with how committed it is to addressing practice variation and how it will accomplish that work.

Three of the 17 hospitals rated high in readiness for this component because of prework around standardizing the order management process. They had already begun efforts to standardize disease-specific ordering practices, the medication formulary, clinical documentation, and medication administration times.

Access to Information

One of the big gains physicians hope to derive from CPOE is having ready access to a core set of patient data from anywhere in the hospital and remote sites (home or office). This component focuses on the availability of electronic clinical data and the ease of access to this information. Hospitals in this group were almost evenly split, with 10 having a rating of ≤ 50 for this readiness component. Hospitals with high scores had established remote access for physicians and had been steadily increasing the amount of clinical data, reference information, and other functions available. Greater physician experience with use of computers as part of their normal work translates into a much shorter learning curve for CPOE.

IT Composition

The pattern noted for access to information was also found for the IT Composition component, which looks at the IT department's capacity to support CPOE implementation and ongoing maintenance. Organizations that had experience with clinical systems and supporting

clinical users had clinician-focused help desk processes and IT training. Low scores in this component usually indicate the need to expand and integrate clinical expertise within IT. The increased support demands of CPOE have caused many organizations to reevaluate their IT operations models, including 24-hour, 7-day support and coordinated change management processes.

Information Technology Infrastructure

Readiness in terms of IT infrastructure comes from effective technology planning and implementation before the CPOE rollout. Most hospitals must upgrade network, desktop support, processing power, and redundancy to meet CPOE access and system performance requirements. The majority of hospitals had already implemented high-performance networks and made remote system access available to physicians, although they still had gaps in areas such as system management tools, user device types, and system availability. Many of the hospitals were struggling to determine the effective deployment of devices for mobile users and redefined workflows. CPOE forces a change in how hospitals manage system availability, insofar as it is a mission-critical application that demands unprecedented levels of system availability and performance within health care. This demand is presenting a challenge for the IT department and many application vendors.

Conclusions

Most of the assessed hospitals had significant gaps in their CPOE preparedness, many of which would have needed to be addressed with action plans well in advance of implementation. CPOE readiness gaps that are distributed across the components translate into longer and more multifaceted readiness plans.

Table 3 (p 343) lists some of the typical action items to build CPOE readiness.

Plans for individual hospitals have to be tailored to the mix of strengths and weaknesses, as well as the culture, of the organization. Culture is reflected in the way that the leadership team works with the medical staff and that the physicians are integrated into existing structures for decision making. Some of the biggest challenges lie in building or enhancing the relationship between the hospital and the physician community. A significant investment of time, money, and other resources is generally required in the technology infrastructure to provide appropriate access, mobility, and performance. In any CPOE implementation, these issues must be addressed for the improvements in quality and safety to be fully realized.¹⁷⁻²⁰

Assessing CPOE readiness has revealed gaps in every hospital examined so far. Identifying gaps early and factoring the projects to address readiness into the clinical system implementation time line reduces the risks of false starts and stalled efforts. The level of change involved with CPOE is much greater than hospitals have faced in the past, and success requires that the organization become expert at accomplishing and sustaining change. Understanding and building readiness is an important first step. **1**

Dona Stablein, RN, MBA, is Director; Emily Welebob, RN, MS, is a Senior Manager; and Elizabeth Johnson is a Service Consultant, Consulting Patient Safety Practice, First Consulting Group, Salt Lake City. Jane Metzger is Director, Emerging Practices; Robert Burgess is Director, Business Development, Technology Services; and David C. Classen, MD, MS, is Vice President, Consulting Patient Safety Practice. Please address requests for reprints to Dona Stablein, dstablein@fcg.com.

Table 3. Typical Action Items to Build Computerized Physician Order Entry (CPOE) Readiness

Readiness component	Description	Possible action items
External Environment Market Regulation	External and internal forces that are pushing the organization to implement CPOE	Identify primary reasons to implement CPOE Craft messages to build the case for CPOE Start educational and marketing campaign Document and share the experiences of other organizations that have implemented CPOE
Organizational Leadership Accountability Vision Planning	The organization's commitment to CPOE as a top strategic priority	Establish executive accountability for CPOE Obtain budget approval Establish priorities for strategic initiatives Develop and gain consensus around a clinical vision for the organization
Organization Structure and Function Physician Model Resources Communication	The presence and effectiveness of organizational structures, relationships, and processes needed to implement and maintain CPOE	Develop a plan to engage the medical staff Define project structure, roles, and accountability Create a CPOE communication plan Define CPOE value and a plan for measurement
Organizational Culture Success with improvement CPOE awareness Innovation	The organization's capacity to engage in and sustain large-scale change that has a significant impact on clinical practice	Develop and formalize incentives for physician participation in CPOE Foster clinical ownership of clinical information technology (IT) Assess CPOE knowledge and expectations and develop plan to close gaps
Care Standardization Commitment Experience Compliance	The organization's ability to adopt or develop standard care processes and implement them across the organization	Establish goals for reducing unnecessary variation in clinical practice (including, but not limited to, protocols) Standardize clinical documentation practices where appropriate Establish structures and processes to support care standardization
Order Management Process Standardization Management Compliance	The present state of order management services, disciplines, and processes	Assess order management process Establish standards for order management process Develop policies and procedures to support new processes
Access to Information Availability of patient information Clinician use Clinical decision support	Clinician experience with clinical computing as an element of routine clinical work	Increase physician use of current clinical information systems Deploy high-value automated tools to clinicians Improve the reliability of patient-specific core clinical data Develop clinical decision support strategy

continued

Table 3. Typical Action Items to Build Computerized Physician Order Entry (CPOE) Readiness (continued)

Readiness component	Description	Possible action items
Information Technology Composition Clinician Involvement IT services and support	The roles, skills, structure, and methodologies of the IT department	Develop/enhance clinical systems support in IT Build mechanisms for medical staff/IT liason Upgrade help desk and service levels to accommodate CPOE Develop training plan and resources
Information Technology Infrastructure Performance Availability Devices	The physical infrastructure and technical components of CPOE	Right-size technology infrastructure, especially number and types of devices for CPOE Develop business continuity plan, upgrade infrastructure, and adjust processes as appropriate Develop access plan to address needs of the mobile clinician

References

1. The Gartner Group: *Physician Order Entry Systems: The Balance Is Shifting*, Gartner Research Notes, Jun 7, 2002.
2. KLAS Enterprises: *CPOE Digest (Computerized Physician Order Entry)*. Draper, UT, 2003.
3. Metzger J, Turisco F: *Computerized Physician Order Entry: A Look at the Vendor Marketplace and Getting Started*. Washington, DC: The Leapfrog Group and First Consulting Group, Dec 2001.
4. First Consulting Group: *Computerized Physician Order Entry: Costs, Benefits and Challenges, A Case Study Approach*. Commissioned by the American Hospital Association and the Federation of American Hospitals. Chicago, Jan 2003.
5. Birkmeyer C, et al: Will electronic order entry reduce health care costs? *Eff Clin Pract* 5(2):67-74, 2002.
6. Stead W, Sittig D: Computer-based physician order entry: The state of the art. *J Am Med Inform Assoc* 1(2):108-123, 1994.
7. Teich J, et al: Toward cost-effective, quality care: The Brigham Integrated Computing System. In Steen EB (ed): *Second Annual Nicholas E. Davies CPR Recognition Symposium*. Washington, DC, May 1-2, 1996.
8. McDonald C, et al: The three-legged stool: Regenstrief Institute for Health Care. In Teich JM (ed): *Proceedings of the Third Annual Nicholas E. Davies CPR Recognition Symposium*. Washington, DC, June 19-20, 1997.
9. Grandia L, et al: Building a computer-based patient record system in an evolving integrated health system. In Steen EB (ed): *Proceedings of the First Annual Nicholas E. Davies CPR Recognition Symposium*. Washington, DC, April 4-6, 1995.
10. Metzger J, Fortin J: *Computerized Physician Order Entry (CPOE) in Community Hospitals: Lessons from the Field*. Oakland, CA: California HealthCare Foundation, 2003.
11. Massaro TA: Introducing physician order entry at a major academic medical center: I. Impact on organizational culture and behavior. *Acad Med* 68(1):20-25, 1993.
12. Langberg M: Challenges to implementing CPOE: A case study of a work in progress at Cedars-Sinai. *Modern Physician*, Feb 2003, pp 21-22.
13. Kilbridge P, Welebob E, Classen D: *Overview of The Leapfrog Group Test Standard for Computerized Physician Order Entry*. Washington, DC: The Leapfrog Group and First Consulting Group, Nov 2001.
14. Computer-Based Record Institute: *A Framework for Evaluating Computer-Based Records and Guidelines for Applying to the Davies Recognition Program*. Chicago: Healthcare Information and Management Systems Society. www.himss.org/content/files/Davies%20Award%202003.pdf (accessed Apr 9, 2003).
15. The Leapfrog Group: *Fact Sheet. Computerized Physician Order Entry (CPOE)*. Washington, DC, Nov 2000. www.leapfroggroup.org/FactSheets/CPOE_FactSheet.pdf (accessed Apr 9, 2003)
16. Rogers EM: *Diffusion of Innovations*. New York: The Free Press, 1995.
17. Leape LL, Berwick DM, Bates DW: What practices will most improve safety? Evidence-based medicine meets patient safety. *JAMA* 288:501-507, 2002.
18. Evans RS, et al: A computer-assisted management program for antibiotics and other anti-infective agents. *N Engl J Med* 338:232-238, 1998.
19. Kilbridge P, Classen D: Surveillance for adverse drug events: History, methods and current issues. *VHA 2002 Research Series, No. 3*. Irving, TX: VHA Inc, 2002.
20. Bates DW, et al: Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. *JAMA* 280:1311-1316, 1998.